# Contaminants in Great Lakes Herring Gulls, 1974-2001

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# Herring Gull (Larus argentatus)

# A normal 3 egg Herring Gull clutch.

# Herring Gulls are non-migratory as adults on the Great Lakes.

# Herring Gull Annual Monitoring Colonies


1. Strachan I.
2. Snake I.
3. Toronto Hrbr.
4. Hamilton Hrbr.
5. Niagara R.
6. Port Colborne
7. Middle I.
8. Fighting I.
9. Chantry I.
10. Double I.
11. Channel-Shelter I.
12. Gull I.
13. Big Sister I.
14. Agawa Rks.
15. Granite I.

**BTS Charge**: Present temporal trend data for critical pollutants on a lake basis for the last 5 years

**CWS Approach**: Change-Point Regression on site specific data, 1974-2001

# Change Point Regression

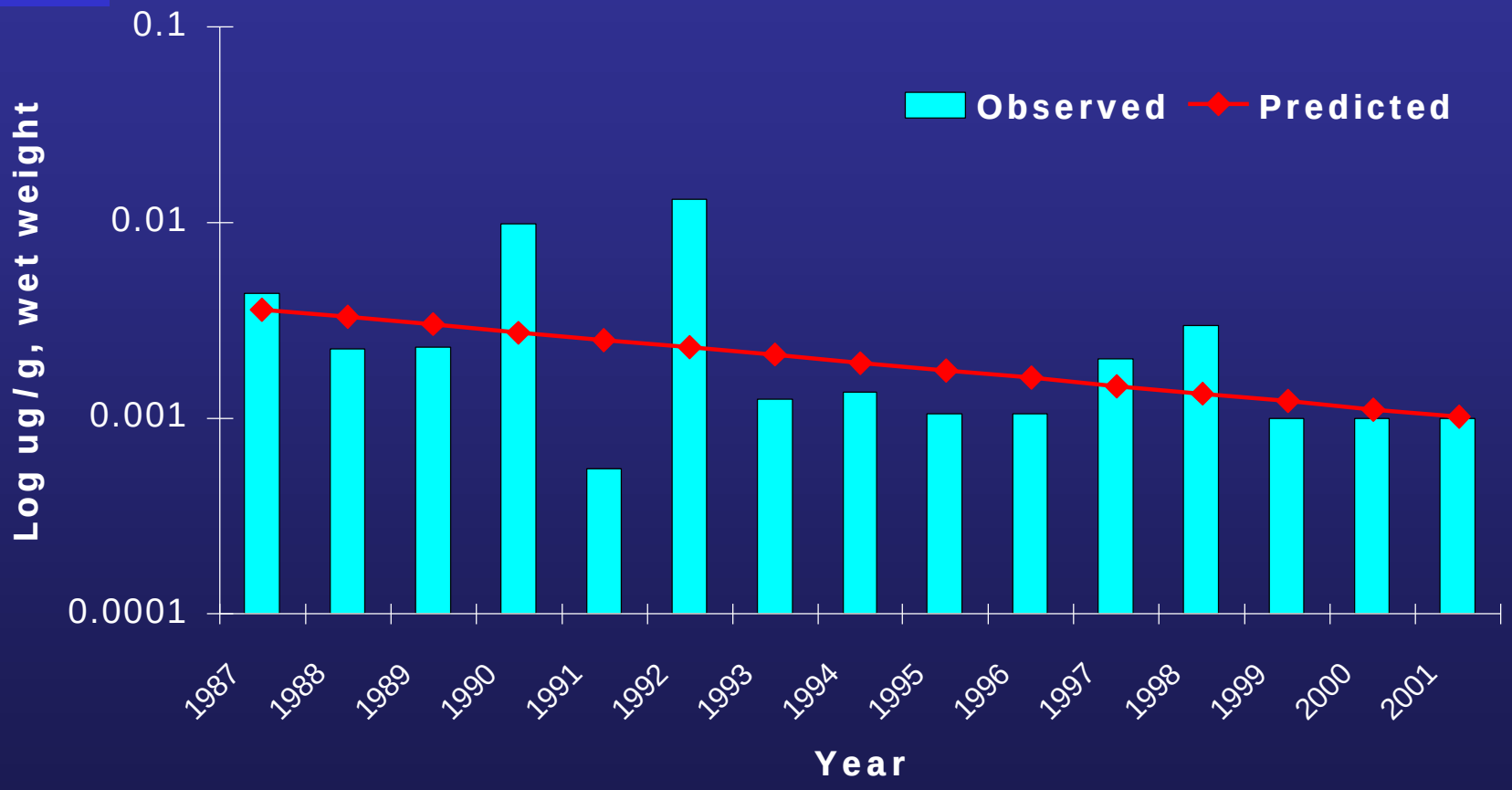
**A statistical method to detect a change (in slope) within a given temporal dataset.**

**CWS:** Most contaminants have declined since the 1970s. Have they declined at a constant rate or has the rate of decline changed (slowed) over the course of study?

# Change Point Regression
## 4 Possible models

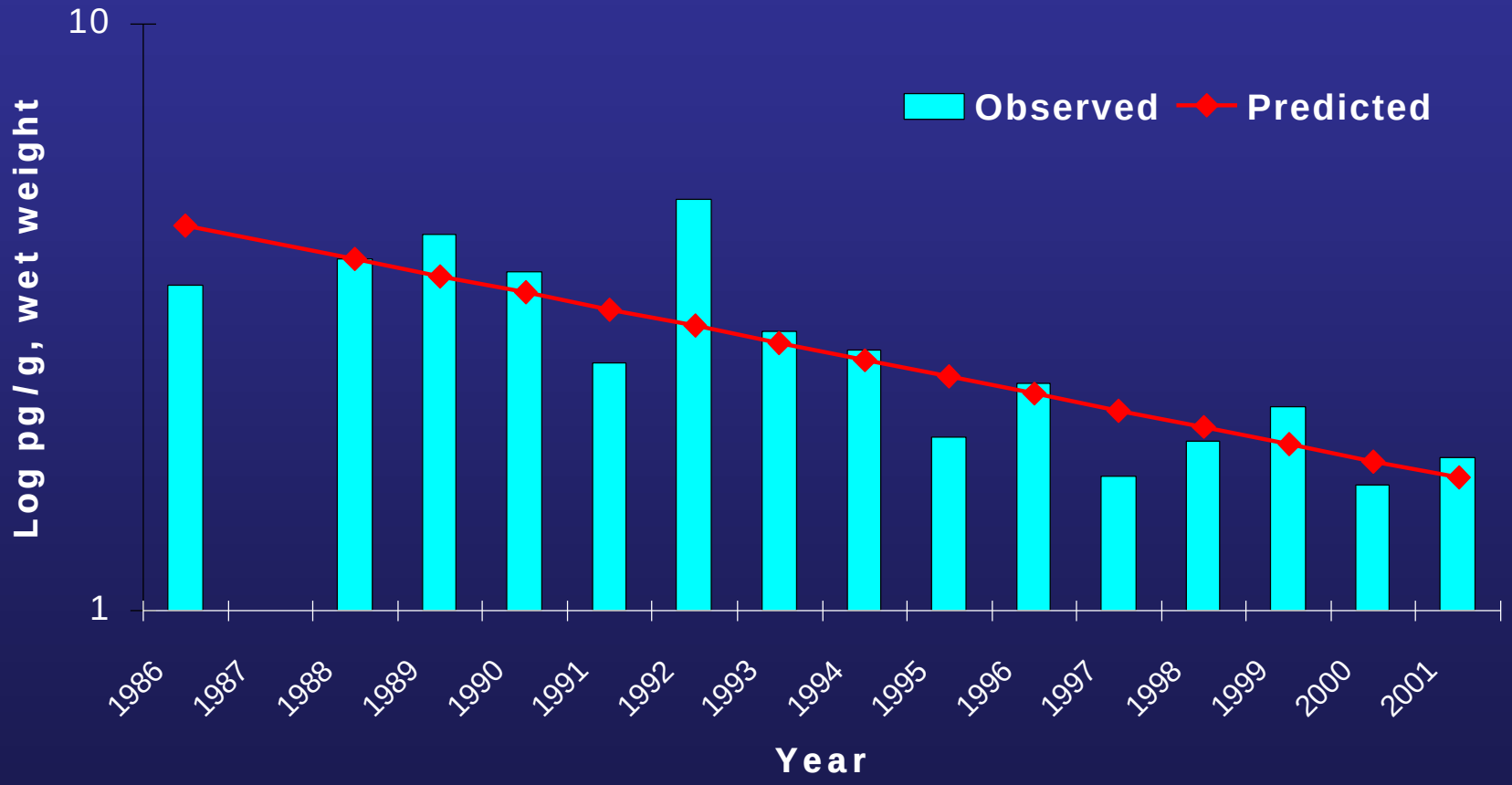
- Stable over the study period, slope = 0, no change point.
- Constant rate of decline throughout the study period, no change point.
- Change point, slopes do not differ before and after CP (=constant rate)
- Change point, slopes differ before and after CP
  - Declining faster after CP
  - Declining slower after CP
    - Continuing to decrease
    - Increasing

# OCS in Herring Gull eggs - Big Sister I., Lake Michigan, 1986-2001




**Rate is non-significant and there is no change point**

# DDE in Herring Gull eggs - Strachan I., St. Lawrence R., 1986-2001

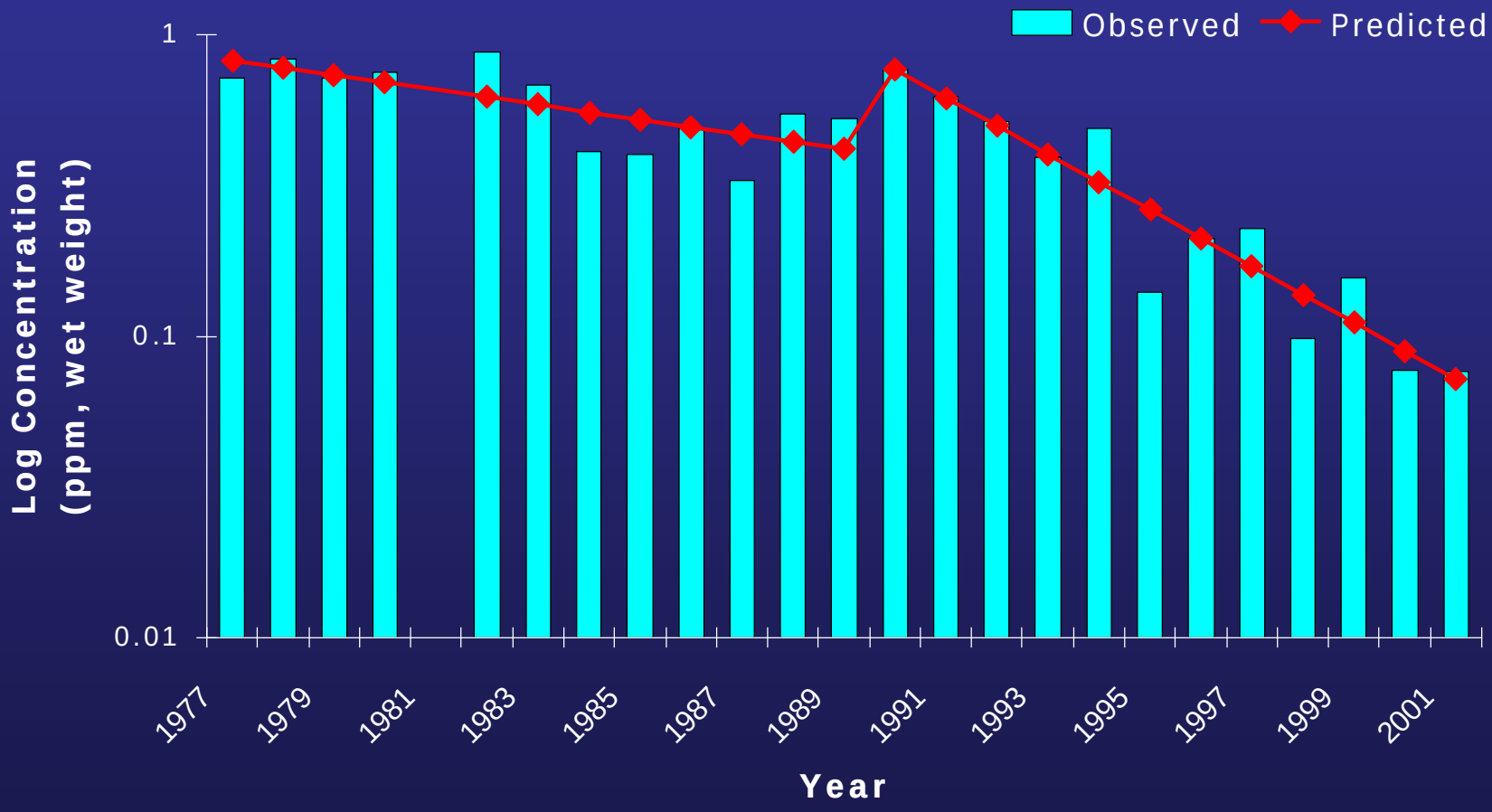



**Model shows a constant rate of decline with no change point**

# HCB in Herring Gull eggs - Double I., Lake Huron, 1974-2001


**Model shows the same significant rate of decrease before and after the change point in 1992**

# Dieldrin in Herring Gull eggs - Gull I., Lake Michigan, 1977-2001




**Model shows significant declines, and faster after the change point in 1990.**

# 2,3,7,8-Dioxin in Herring Gull eggs - Fighting I., Detroit R., 1984-2001

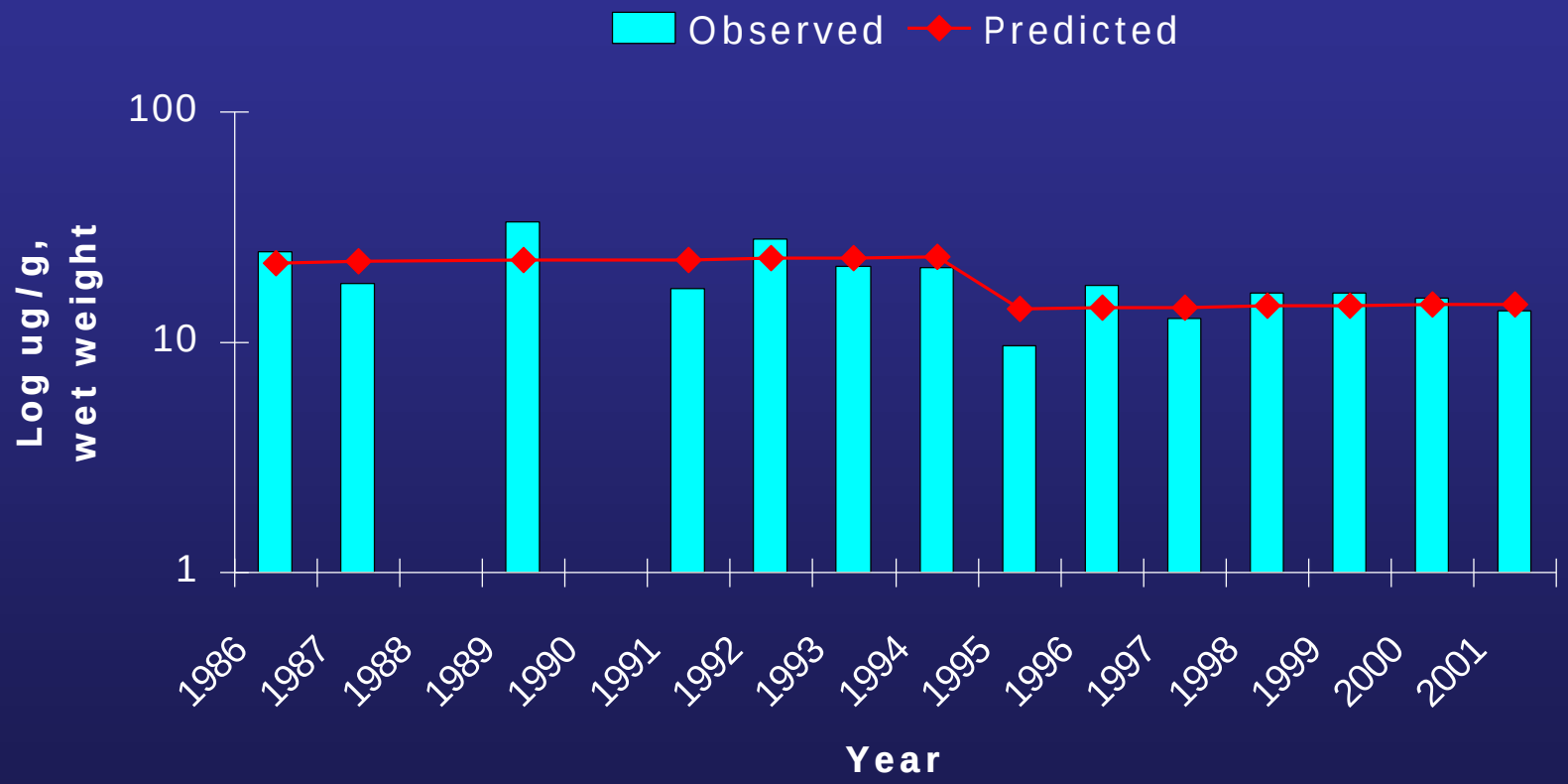

**Model shows a significant decline before the change point in 1996 and a significant increase after 1996.**

# Results of change-point analysis for all sites.

| SITE | | COMPOUND | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | PCB 1:1 | Mirex | HCB | TCDD | DDE | Dieldrin | OCS |
| SLR | Strachan I. | | | | | | | |
| LO | Snake I. | | | | | | | ** |
| LO | Toronto Harbour | | | | | | | |
| LO | Hamilton Harbour | ** | | | | | | |
| NR | Unnamed I. | ** | | | | | | |
| LE | Port Colborne | | | | | | | |
| LE | Middle I. | ** | | | ** | | | |
| DR | Fighting I. | | | | | | | |
| LH | Chantry I. | | | | ** | | | ** |
| LH | Double I. | | | | | | | |
| LH | Channel-Shelter I. | | | | ** | | | |
| LM | Gull I. | | | | | | | |
| LM | Big Sister I. | | | | | | | |
| LS | Agawa I. | | | | | | | |
| LS | Granite I. | | | | ** | | | ** |

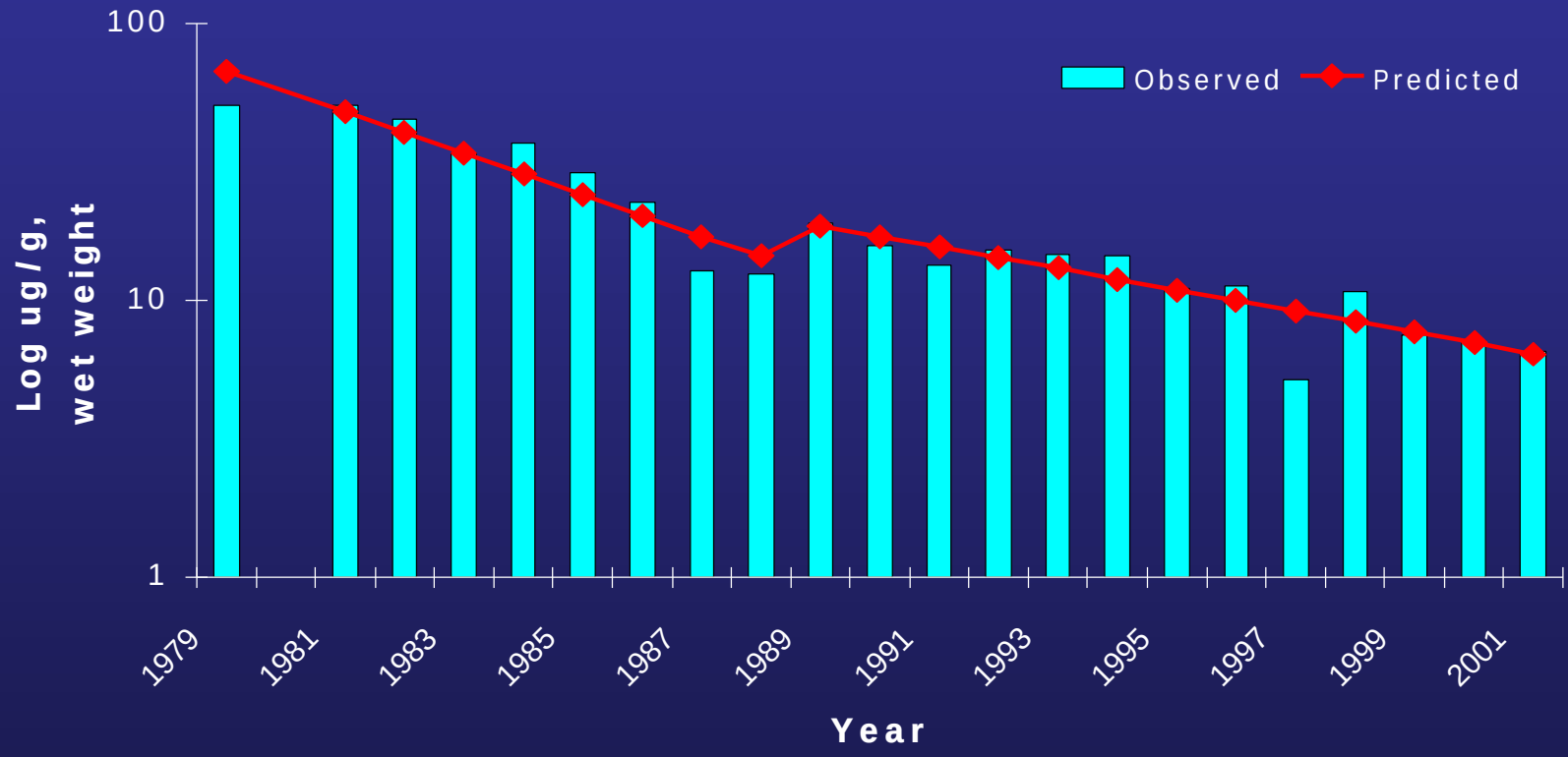
- Constant rate of decline or declining faster than previously
- Declining slower after change point
- No trend, slope = 0
- Increasing after the change point

# PCB 1:1 in Herring Gull eggs - Hamilton Harbour, Lake Ontario, 1986-2001



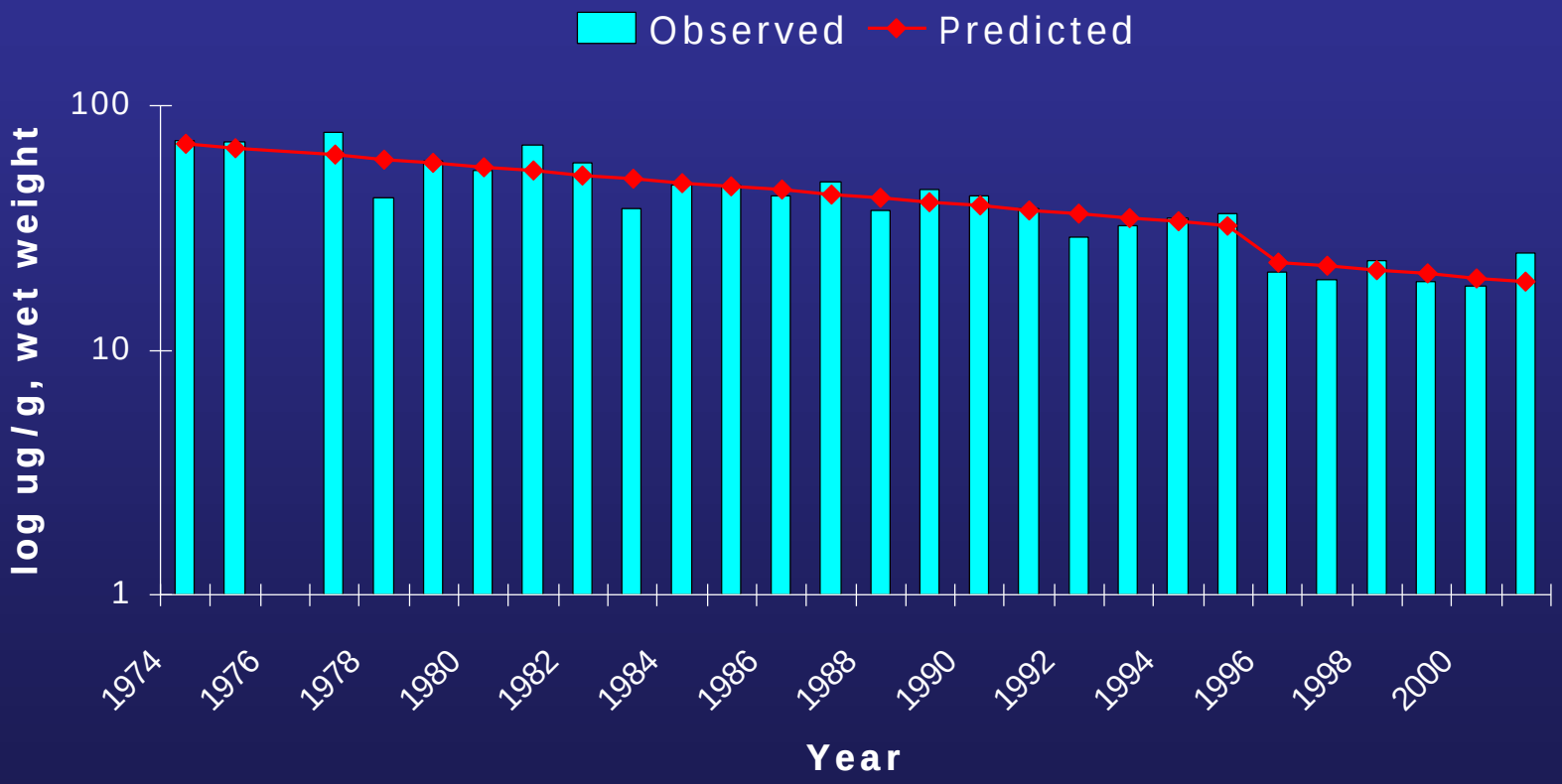

**Model shows the same non-significant increase before and after the change point in 1995.**

# PCB 1:1 in Herring Gull eggs - Niagara River, 1979-2001



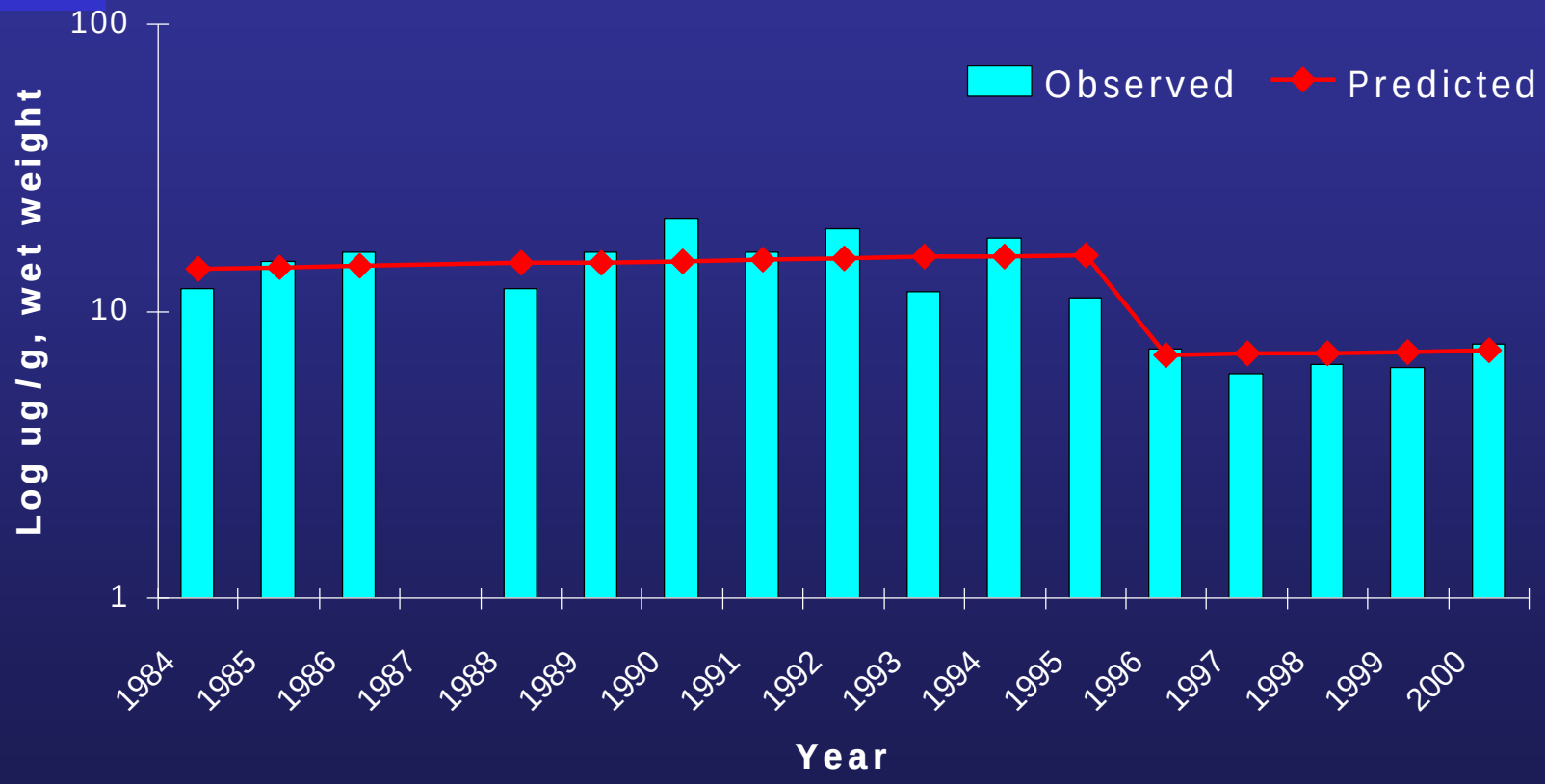

**Model shows a slower rate of decline after the change point in 1989.**

# PCB 1:1 in Herring Gull eggs - Middle I., Lake Erie, 1974-2001




**Model shows the same significant rate of decline before and after the change point in 1996.**

# 2,3,7,8-Dioxin in Herring Gull eggs - Middle I., Lake Erie, 1984-2001

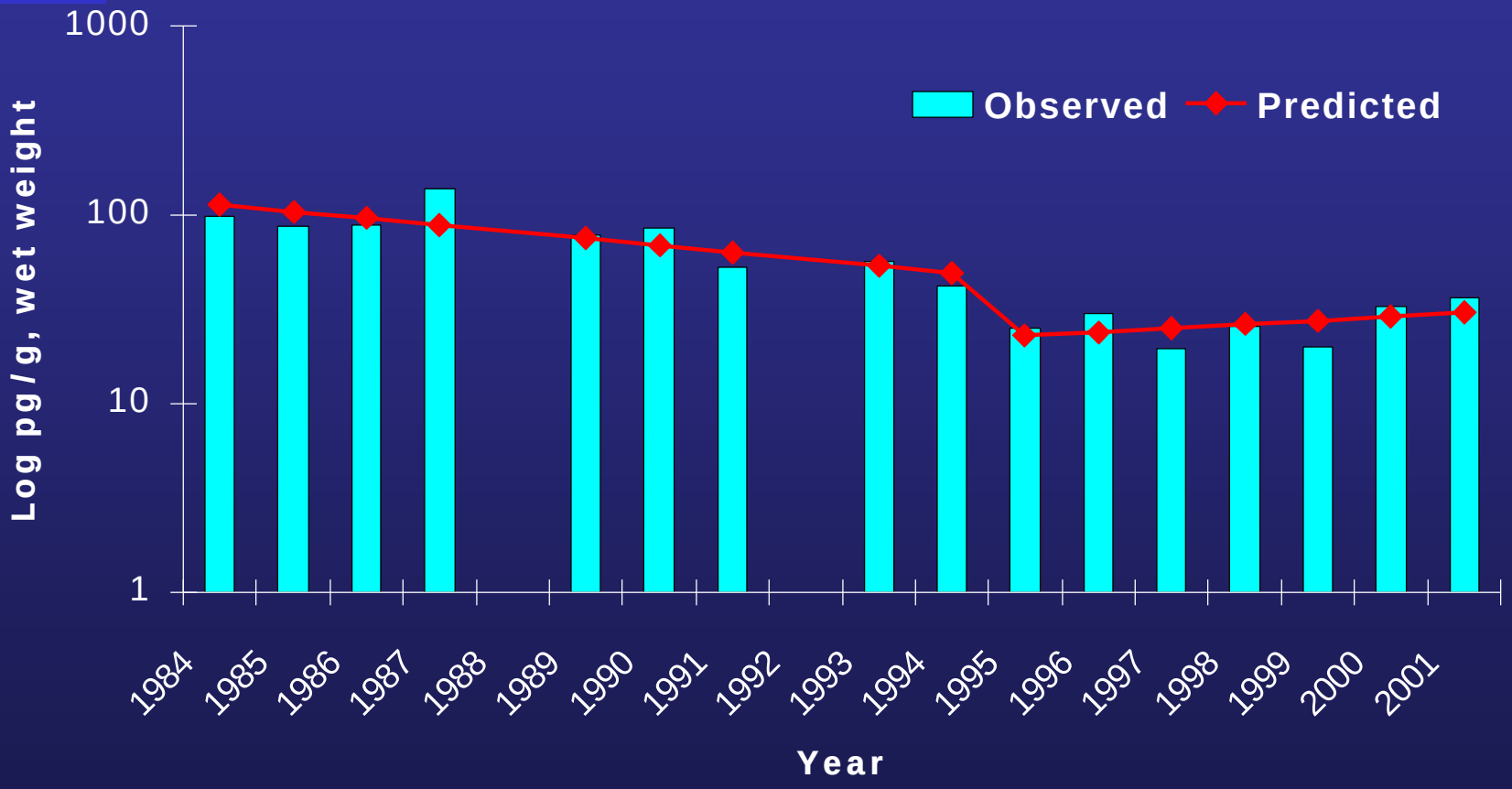



**Model shows the same non-significant trend before and after the change point in 1996.**

# 2,3,7,8-Dioxin in Herring Gull Eggs - Chantry I., Lake Huron, 1984-2001


**Model shows the same significant rate of decline throughout the study period.**

# 2,3,7,8-Dioxin in Herring Gull Eggs - Channel-Shelter I., Lake Huron, 1984-2001

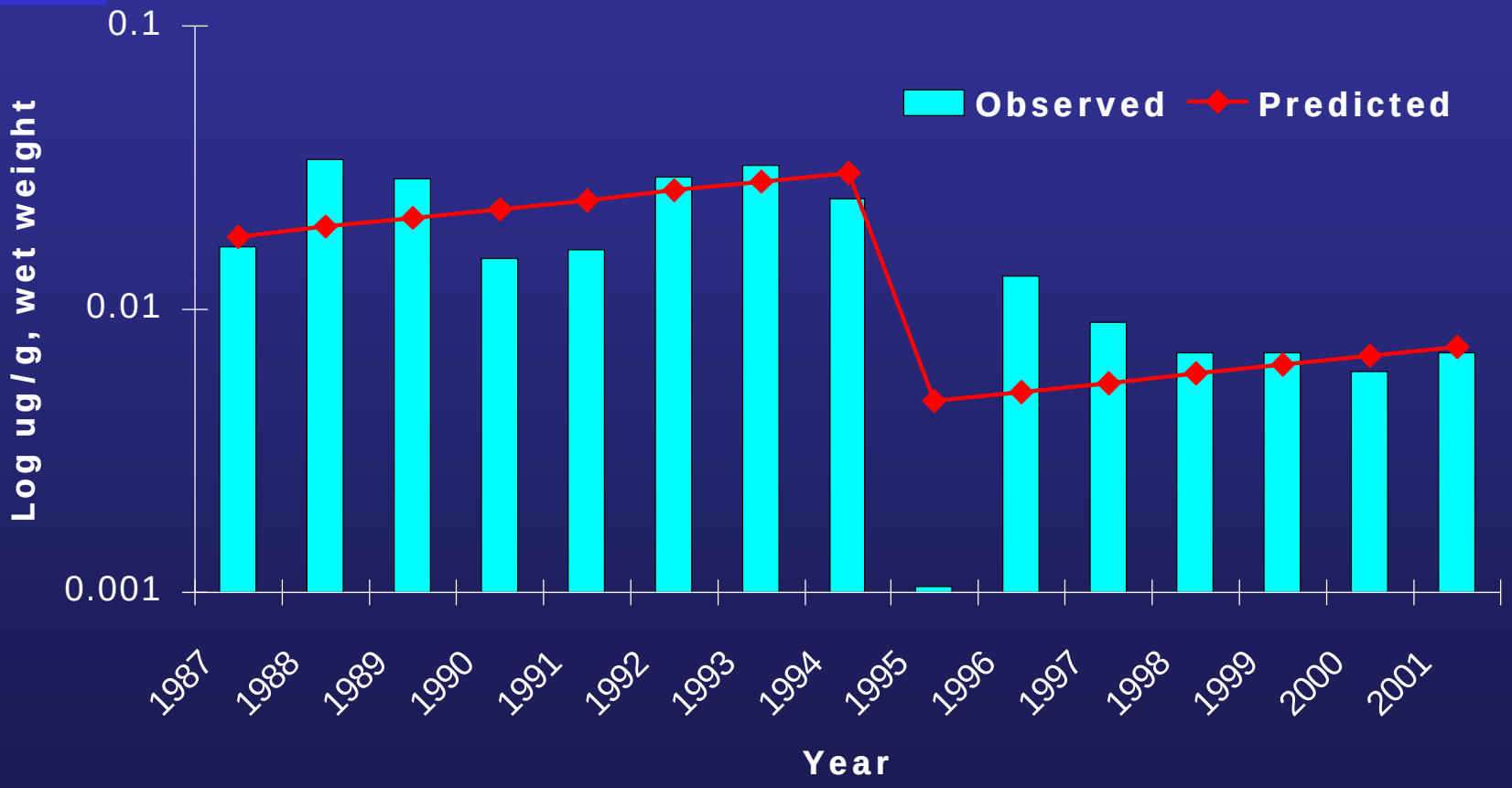



**Model shows a significant decline before the change point in 1995 and a non-significant increase after.**

# 2,3,7,8-Dioxin in Herring Gull eggs - Granite I., Lake Superior, 1984-2001

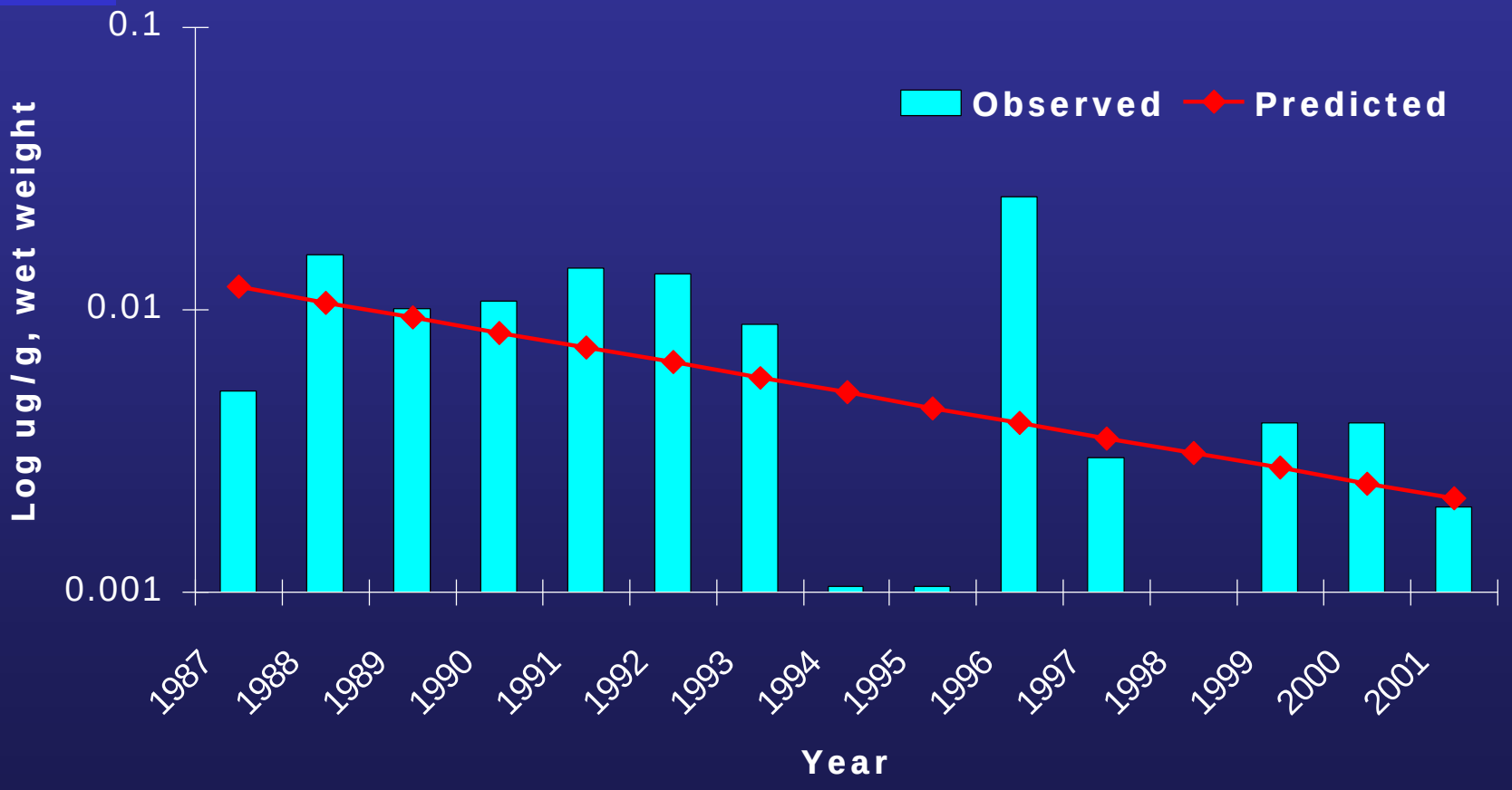

**Model shows a non-significant trend before the change point and a significant increase after the change point in 1995.**

# OCS in Herring Gull Eggs - Snake I., Lake Ontario, 1987-2001



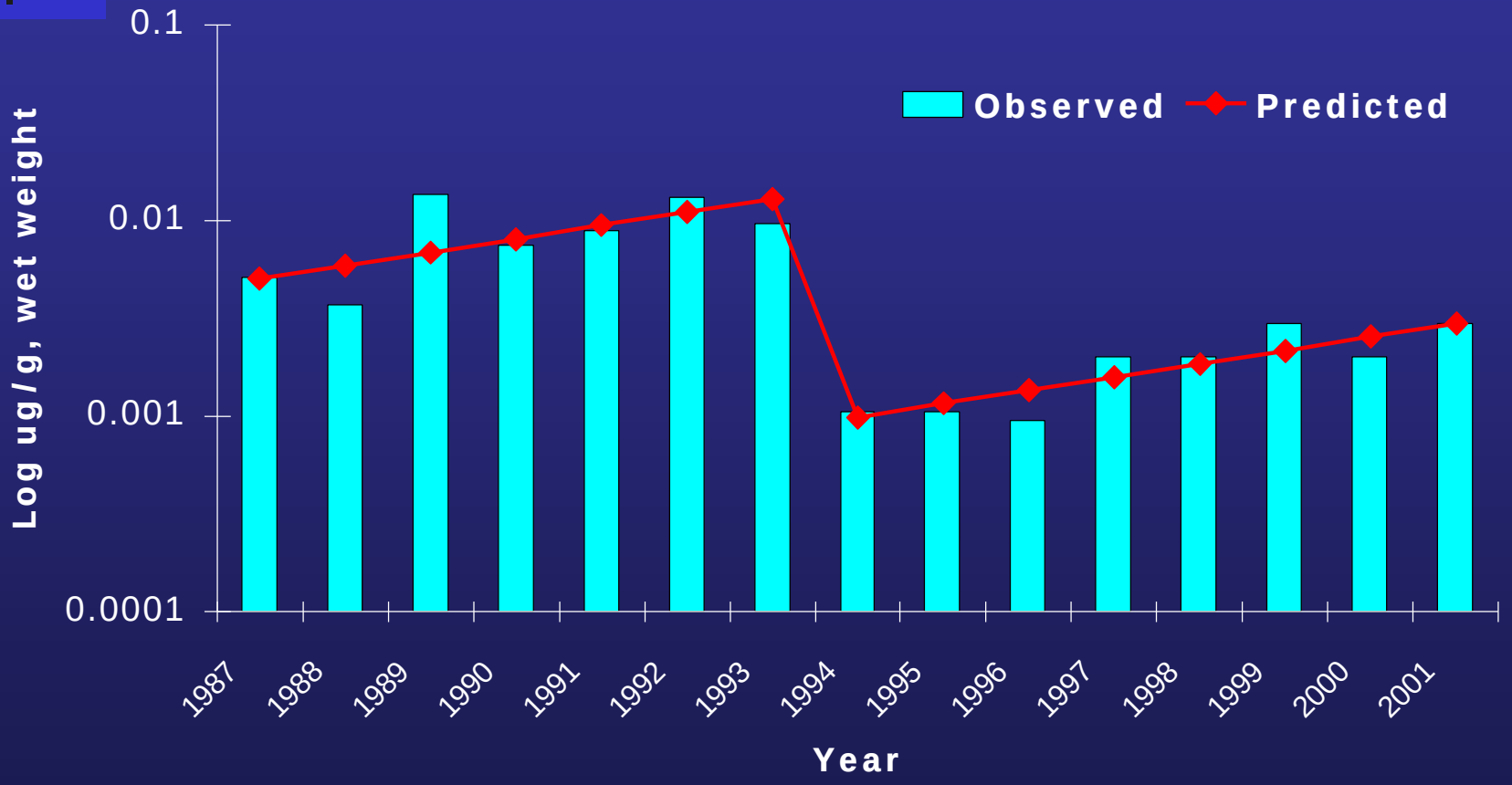

**Model shows the same non-significant rate of increase before and after the change point in 1995.**

# OCS in Herring Gull Eggs - Chantry I., Lake Huron, 1987-2001




**Model shows the same significant rate of decline throughout the study period.**

# OCS in Herring Gull Eggs - Granite I., Lake Superior, 1987-2001

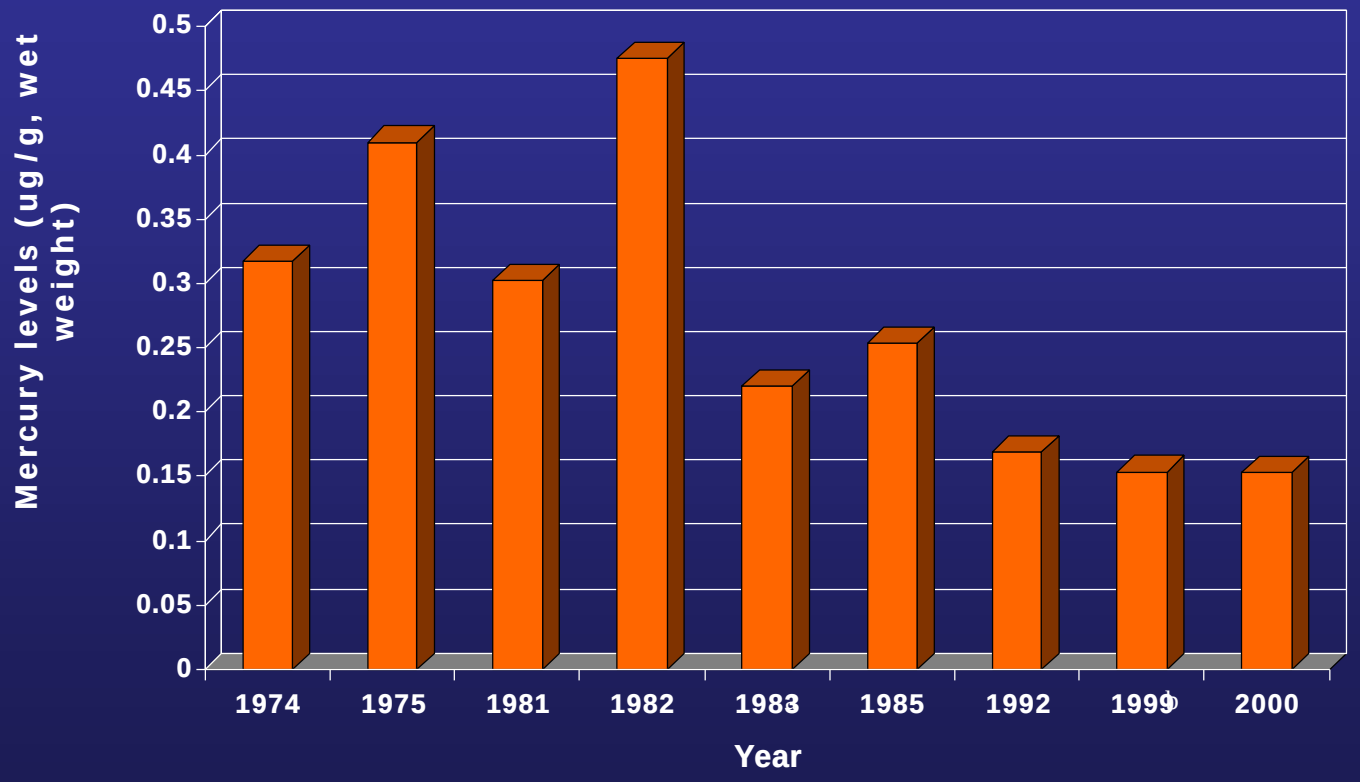



**Model shows the same significant rate of increase before and after the change point in 1994.**

# Summary - change point analysis

| | % occurrence by model | | | |
|---|---|---|---|---|
| Water Body | | | | |
| SLR | 86 | 0 | 14 | 0 |
| LO | 33 | 29 | 33 | 5 |
| NR | 57 | 29 | 0 | 14 |
| LE | 86 | 0 | 14 | 0 |
| DR | 57 | 14 | 14 | 14 |
| LH | 52 | 29 | 19 | 0 |
| LM | 42 | 29 | 29 | 0 |
| LS | 50 | 29 | 7 | 14 |

# Mean mercury levels in Herring Gull eggs at eight Great Lakes colony sites.




aGranite Isl. did not have data for 1983.
bToronto Hrbr. did not have data for 1999.

**Lake Ontario**
Snake Island
Toronto Harbour

**Lake Erie**
Port Colborne
Middle Island

**Lake Huron**
Chantry Island
Double Island

**Lake Superior**
Agawa Rock
Granite Island

# Take Home Message

1. The Herring Gull program gives annual data, 1974-2001 (2002).

In Herring Gull Eggs

2. Of compound presented here, Mirex, DDE, HCB and Dieldrin are declining as fast or faster than previously.

3. PCBs are declining as fast or faster at 33%, more slowly at 53% of sites.

4. OCS is stable at 60% of sites, increasing at 13%.

5. TCDD is stable at 40% of sites, increasing at 20%.

6. Lake Ontario has the fewest compounds declining as previously (33%).

7. Lake Erie has the most (86%).

8. Mercury shows declines 1980s-2000, 1992-2000